

Application No.: 10/620,865

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REMARKS

Claims 1-17 were pending in the present application. By virtue of this response, claims 1-10, and 15 have been cancelled, and claims 11, 16, and 17 have been amended. Accordingly, claims 11-14, and 16-17 are currently under consideration. Amendment and cancellation of certain claims is not to be construed as a dedication to the public of any of the subject matter of the claims as previously presented. No new matter has been added.

Rejections under 35 U.S.C. §103(a)

Claims 11-17 are rejected under 35 U.S.C. §103(a) as being unpatentable over Reid (US 2003/0210720, hereinafter Reid) in view of Onomura et al. (US 2002/0039374, hereinafter Onomura). Applicants respectfully traverse these rejections.

As amended, Claim 11 includes the limitations of a support member, a solder for joining the laser chip to the support member, a multilayer metal film including the outermost layer of Au formed on said nitride semiconductor laser device chip, and an outermost layer of Au is bonded to the support member with the solder. Neither Onomura nor Reid, or the combination of the two has disclosed, taught, or suggested these claim limitations. These requirements are used for applying stress from the outside to the laser chip so as to elongate the lifetime of the laser device.

Applicants respectfully submit that the Examiner's contention that Onomura teaches a multilayer metal film comprising an outermost layer of Au is formed on a second surface of the semiconductor substrate is incorrect. In Onomura, a multilayer metal film in the order of Ti/Pt/Au is formed not on a laser chip but on a support member. The nitride semiconductor layers are restricted to have particular compositions so as to reduce cracks and crystal defects therein.

On the contrary, the present invention teaches that the multilayer metal film formed on the laser chip has its outermost layer to be Au and the solder includes one of AuSn, AgSn, AuGe, PbSn, InSn, and AgCuSn. The benefit is that the laser chip can be fixed tightly to the support member by using the Au outermost layer formed on the chip and the solder having a good wettability with the

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Au outermost layer. In other words, Onomura does not teach or suggest forming an outermost layer of Au as described in the present application. As a result, the semiconductor laser chip taught by Onomura can not be fixed tightly to the outermost layer included in the multilayer metal film formed on the support member. In addition, the compositions of the nitride semiconductor layers of the present invention are not restricted. The dimensions of the laser chip can readily be adjusted so as to elongate the lifetime of the laser device.

The present invention is further distinguished from Reid. In Reid, InGaAsP semiconductor has a cubic crystallographic structure. A semiconductor laser device of a cubic crystal system is formed on a (001) surface of a substrate of the same cubic crystal system. The semiconductor laser device is divided into chips along crystallographic planes (110) and (1-10) which are equivalent. Reid is further differentiated from the case of the hexagonal crystal system of the present invention, where the anisotropic internal stress in the chip of the cubic crystal system is applied to such equivalent crystallographic planes and thus does not seriously affect physical properties of the semiconductor layers nor affect properties of the semiconductor laser device. In other words, the present invention is effective in the case of the nitride semiconductor laser device having the hexagonal crystal system. Therefore, Claim 11 includes the limitation of the hexagonal crystal system. More specifically, the nitride semiconductor laser device of the hexagonal crystal system has such anisotropy as mentioned above and thus causes large internal stress due to differences in lattice constant and thermal expansion coefficient between layers during film deposition. The present invention solves the problems caused by such large internal stress in the nitride semiconductor laser device of the hexagonal crystal system.

Furthermore, the nitride semiconductor laser device of a hexagonal crystal system of the present invention is formed on a (0001) surface of a nitride semiconductor substrate of the same hexagonal crystal system. The nitride semiconductor laser device is divided into chips along crystallographic planes (10-10) and (11-20) which are not equivalent. When chips of a rectangle shape (especially with a large length and a narrow width) are cut from a wafer having an internal stress due to lattice distortion etc., internal stress created in the chip becomes anisotropic. The anisotropic internal stress is applied to such non-equivalent crystallographic planes as mentioned

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above and affects physical properties of the semiconductor layers and then properties of the semiconductor laser device. The internal stress in the laser chip of the hexagonal nitride crystal system influences the life time of the laser device. The laser device as described in Claim 11 can have an improved lifetime as shown in Fig. 3 of the present application.

For at least the reasons presented above, Claim 11 and its dependent claims 12-14 and 16-17 should not be found obvious over Reid in view of Onomura.

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CONCLUSION

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue. If it is determined that a telephone conference would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the event the U.S. Patent and Trademark office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no. 245402006600. However, the Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

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